APPENDIX

Attached hereto is the Declaration under 37 CFR 1.132 of Wu Jian Kang (11 pages).

S/N 09/810,971 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Huang et al.	Examiner:	Michael J. Simitoski
Serial No.:	09/810,971	Group Art Unit:	2134
Filed:	March 16, 2001	Docket No.:	10984.3USI1
Customer No.:	23552	Confirmation No.:	7444
Title:	Optical Watermark		

DECLARATION UNDER 37 C.F.R. § 1.132

I, Wu Jian Kang, of Block 51, Teban Gardens Road #06-565, Singapore 600051, do declare and say as follows:

1. I am a named inventor for U.S. Patent Application Serial No. 09/810,971 (hereinafter called the "Application"). I am also duly authorized to make this Declaration on behalf of Trustcopy Pte Ltd. I enclose a copy of my resume detailing my extensive background and experience in optical watermark technologies.

2. I have reviewed the Office Action dated April 7, 2005 from the U.S. Patent Office related to the Application. I have also reviewed U.S. Patent No. 6,104,812 to Koltai et al. (hereinafter called the "Koltai"). It is my understanding that all of the pending claims of the Application are rejected as being anticipated by or obvious in view of Koltai.

3. It is my opinion that one skilled in the art at the time of invention would understand the term "modulation" to mean the transmission of a signal by imposing it on a carrier wave by changing the carrier's amplitude, frequency or phase. See, for example, the attached WordNet dictionary (available on the Internet at http://dict.die.net/) definition for the term "modulation."

4. In other words, in my opinion, one skilled in the art at the time of invention would interpret "modulation" to mean an interaction between two things: a signal and a carrier wave.

5. Thus, I believe that one skilled in the art at the time of invention would understand the phrase "phase modulation" to mean the transmission of a signal by imposing it on a carrier wave by changing the carrier's phase.

6. As used in the context of the present application, I believe one skilled in the art at the time of invention would understand the phrase "phase modulation" to mean embedding of a latent

image into a watermark layer by imposing the latent image on a dot pattern carrier by changing the dot pattern's phase. See, for example, pages 6 and 7 of the Application.

7. In my opinion, one skilled in the art would not interpret the simple alteration or repositioning of dots as disclosed by Koltai (see, for example, column 4, lines 11-16 and Figures 10 and 19A) as "phase modulation."

8. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and the like are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of this application or any patent issuing thereon.

Date: Dec. 8, 2005

Wu Jian Kang

05/05/05

Curriculum Vitae

Jian Kang Wu
Principal Scientist, Institute for Infocomm Research (I^2R), Singapore
Adjunct Professor, University of Science and Technology of China
Tel: +65 874 8290 (office), +65 9863 8065 (mobile) email: jiankang@i2r-a-star.edu.sg
Address: BLK 51, Teban Gardens Road, #06-565, Singapore 600051

1 Summary

- Principal scientist, department manager of New Initiatives in I^2R, led the "self-renewal effort" for the Institute for Infocomm Research, creating and growing new and competitive research directions. Successfully initiated two new research programs: "NeuroInformatics for Brain-Machine Interface" and "Collaborative and Distributed Information Processing in Sensor Networks", obtained good research results.
- Principal member, deputy director in Kent Ridge Digital Labs (KRDL, Jan 1998 – Mar 2002) and manager of RWC Lab in the Institute of Systems Science (ISS, Feb 1992 – Dec 1997), built his group (Visual Information Processing Group, VIPG) as "*one of the pioneer groups in the world in this field*" (a reviewer comments of the book in 1998).
- Initiated and led large international collaborations, with famous research institutions including MIT, John Hopkins, France CNRS, University of Tokyo, and Japan Real World Computing Partnership.
- Founder and CEO, TrustCopy Pte Ltd, a spin-off high-tech company from KRDL Created a suite of innovative technologies, developed viable products, secured large customers/partners including HP and Citibank, attracted S$7 million fund from 3i, a world leading venture Capital Firm in Jan 2002. Giga Information Group (09/2001): "*Dr. Wu, TC's CEO, is an exceptionally bright visionary. Trustcopy links the printed and electronic world in a unique and useful way. The market for products like Trustcopy represents a significant opportunity*"
- Built himself as a leading professor in China in the field of pattern recognition in 80s, by co-establishing China Association of Pattern Recognition, leading several large scale national projects, and won prestigious awards.
- 25 years experience in graduate education, both as a professor in the University of Science and Technology of China (1981-1992) and under the National University of Singapore (from 1992).
- 18 patents (awarded and pending), 5 books, and 100+ publications
- Serve as chair and program committee member for international conferences, editor of international journals. Initiated and chairing International Workshop on Sensor Networks and Applications (2005)
- Working experience in US, UK, Germany, France, Japan, China and Singapore.
- Titles and Awards from China National Science Congress, Ministry of Science, Ministry of Education and Chinese Academy of Science.

2 Education

- B.Sc. from University of Science and Technology of China (1965-1970)
- Advanced Diploma, from University of Science and Technology of China (1972-1974)

- Ph.D from University of Tokyo (1992)

3 Employment Records

- 12.2002 –, Principal Scientist, Department Manager of New Initiatives (Mar 2003- Mar 2005), Institute for Infocomm Research (I^2R), looking into new research directions on Brain Machine Interface, and sensor networks. Head of Sensor Signal Processing Lab (from Apr 2005), focusing on collaborative signal processing in sensor networks.
- 2000-2002 : Founder and CEO, Trustcopy Pte Ltd (web: www.trustcopy.com), a spin-off from Kent Ridge Digital Labs (KRDL), providing products for the delivery, protection and authentication of trusted electronic and original paper documents on a global scale via Internet.
- 1998 – 2.2002: Principal member, Deputy Director, KRDL, a merger of Institute of Systems Science (ISS) and the Information Technology Institute (ITI). Led visual information processing research.
- 2.1992 – 1997: Manager, Real World Computing Lab, Institute of Systems Science (ISS), National University of Singapore
- 1989 – 1993: Professor, University of Science and Technology of China. Led a group "knowledge-based image analysis" with about 15-20 people.
- 1989 – 1990: Alexander von Humboldt research fellow in Univ. of Erlangen-Nurnberg, with Prof. H. Niemann
- 1986: Visiting associate professor in Dept. of Computer Science, Pittsburgh University, with Prof. S.K. Chang
- 1982: Visiting scientist in Tokyo University, Institute of Industrial Science, with Prof. M. Takagi
- 1979 – 1981: Visiting scientist in Imperial College London
- 1970 – 1989: Lecturer, Associate professor, Dept. of Radio Electronics, University of Science and Technology of China.

4 Projects Awarded and Conducted

4.1 International collaborative projects initiated and led

4.1.1 SMA Adaptive Computing (2005 – 2010)

SMA (Singapore MIT Alliances) is a research program between MIT and Singapore research institutions. Adaptive Computing is a research initiative between MIT, NUS (National University of Singapore), NTU (Nanyang Technological University) and I^2R (Institute for Infocomm Research). I am representing I^2R as co-PI, and PI for showcase platform.

4.1.2 Real World Computing Projects (1993-2002)

As a principal investigator, awarded large research fund (total USD 5 million) from Real World Computing Partnership (RWCP) among more than 100 proposals. RWCP was Japan 10 year national initiative for next generation computing (1992-2001). The research was organized as RWC ISS Lab, consisting of two research topics: *Robust Face and Facial*

Expression Recognition, and *Self-organizing Multimedia Information Base*, with the vision to build intelligent user-friendly machine as personal assistant. It was one of four foreign research labs outside of Japan. Extensive research collaboration was conducted with Labs in RWC Central Research Institute, Mitsubishi, Hitachi, and GMD, Germany. The achievements include:

- Two theoretical formalisms: 1) Recognition by recall - a new recognition paradigm for time-varying objects with application to face recognition and 2) Formalism for multimedia content-based retrieval;
- 179 publications, 19 patents and 17 graduate students;
- Two spin-off companies.

4.1.3 NUS-CNRS-KRDL Collaboration (1998-2004)

Initiated a NUS (National University of Singapore)-KRDL-CNRS (National Scientific Research Centre of France) joint lab*: Image Processing and Application Laboratory (IPAL)*, carrying out research on Digital Image and Video Album (DIVA). IPAL is located inside NUS campus, consisting of senior researchers from CNRS, NUS and KRDL. Led the research for the first three years, stepped down because of leading spin-off company, Trustcopy, and requested by the investor.

4.1.4 John-Hopkins University collaboration (1994-1995)

PI for the collaboration with the Dept of Radiology, JHU, to develop multimedia database to aid the diagnosis and repair of abnormal child skull.

4.1.5 University of Tokyo and USTC collaboration (1982-1992)

As PI of USTC side, co-led the collaboration between the University of Tokyo and the University of Science and Technology of China on "knowledge-based Image Analysis". The research was very fruitful with respect to remote sensing applications, and geographic information systems. This is under the collaboration agreement between Chinese Academy of Science and Ministry of Education of Japan.

4.2 Major Research Projects Awarded and Conducted

(I am either the PI of the project, or the project is in my group under my supervision)

1. NeuroInformatics for Brain Machine Interface (Oct 2003 – Mar 2005) - a new research Initiative aiming at developing novel methods for the non-invasive acquisition and analysis of brain signals in order to directly control machines using brain signal. Now, we have developed a novel paradigm and obtained the best results so far for P300 speller. It awarded Samsung DigitALL Hope Grant to develop "Brainy Communicator" for paralyzed persons in Society of Physically Disabled (SPD).
2. Collaborative and Distributed Information Processing in Sensor Networks (CDIP) (May 2004 – Mar 2005) – it is a new research effort to address the new challenges opposed by massively distributed networked sensors. .
3. Watermarking for digital media rights management (1997 -2001, funded by National Science and Technology Board (NSTB)). Obtained fund for a team of 6 researchers working on adaptive image, video, audio and document watermarking for rights management. The research program resulted in good publications and patents.
4. Color map digitization (1996-1997, Funded by Defence Science Organization of Singapore). Delivered a system which was tested by the user to be 2-22 times faster than the best commercial products at the time.

5. Web-based Geographic Information System (GIS) with spatial query language (1995-1996, Funded by NSTB)
6. System for Trademark Archival and Retrieval (STAR) (1994-1995, Funded by NSTB)
7. Computer-Aided Face Image Identification and Retrieval (CAFIIR) (1992-1994, Funded by NSTB and collaborated with Crime Identification Office of Singapore Home Affairs)
8. Object-oriented GIS and its Application for Protection of Soil Erosion in Yellow River Region (1986-1990, National Initiative, conducted by Chinese Academy of Science)
9. Knowledge-based Image Database Systems (1987-1989, NSF China)
10. 3-D Database for Robotic Vision (1987-1990, China National High-Tech Initiative)
11. Computer-Aided design for textile printing (1984-1986, funded by Anhui Textile Research Institute)
12. Remote imagery interpretation for forestry (1983-1985, funded by China Institute for Forestry Survey and Planning)

5 Professional Activities

- Served as member of international advisory board for International Global Spatial Infrastructure, which is participated by major governments and regional authorities.
- Initialised and first chair of biometrics standardisation technical committee, supported by National Computer Board (NCB).
- Led the setting up a GIS Consortium, to provide technical consultant to government agencies regarding national GIS infrastructure, and partnership R&D with companies. Sponsored by NSTB 1995-1997
- Editor for Machine Vision & Applications, an official Journal of International Association of Pattern Recognition
- Initiated International Workshop on Sensor Networks and Applications, and served as steering committee chair, and TPC chair; Serving as program committee members for three regular international conferences: IEEE Visual Information Systems, Multimedia Modelling, and Machine Vision and Applications. Co-chairman for International Symposium of Remote Sensing 1996, and program committee of several other international conferences such as Fourth International Conference on Information, Communications & Signal Processing and Fourth Pacific-Rim Conference on Multimedia (ICICS-PCM 2003)
- Member of editorial board of the IEEE Multimedia Newsletter
- Associate Editor, Pattern Recognition and Artificial Intelligence, an official journal of China Association of Pattern Recognition.
- Committee member, China Association of Pattern Recognition
- Committee member, China Association of GIS.
- Committee member, China Association of Image Communications.

6 Awards

- KRDL Excellent Award, 2000

- Title ''National Research Pioneer'' jointly by the China Ministry of Education the China Ministry of Science and Technology, 1990.
- Title of ''Research Pioneer in '7-5' period'' by Hefei City, 1991.
- Third prize of National Science Award of China, 1990
- First prize from First National Science Congress of China, 1978
- First prize from Chinese Academy of Science, 1989
- Second prize from Chinese Academy of Science, 1989, 1992
- Second prize from Ministry of Forest, 1988, 1990.

7 Selected Publications

(5 books, 18 patents, and 100+ papers)

Books

- J. K. Wu, M. Kankanhalli, J. H. Lim and D. Hong, *Perspectives on Content-based Multimedia Systems*, Kluwer Academic Publishers, New York, 2000
- Wu, J. K., *Neural Networks and Simulation Methods*, Marcel Dekker, Inc., New York, 1994
- J.K.Wu, *Digital Image Analysis*, Communication Press of China, Beijing, 1989, also published by LuLin publisher in Taiwan, a text book for graduates.

International Journal Papers

- Y. Wang, Tele Tan, J.K. Wu, Spatio-temporal Video Segmentation Based on Graphical Models, *IEEE Transactions on Image Processing*, to appear
- Lim, J.H., Wu, J.K., Singh, S., & Narasimhalu, A.D. Learning similarity matching in multimedia content-based retrieval. IEEE Trans. *Knowledge and Data Engineering*, 2001.
- J. K. Wu, Content-based Indexing of Multimedia Databases, *IEEE Trans. Knowledge and Data Engineering*, Vol. 9, No.6, Nov. 1997, pp978-989
- J. K. Wu, A. Desai Narasimhalu, Fuzzy Content-based Image Database, *Information Processing and Management*, June 1998.
- J. K. Wu, A. Desai Narasimhalu, B. M. Mehtre, C. P. Lam, Y. J. Gao, CORE: A Content-based Retrieval Engine for Multimedia Databases, *ACM Multimedia Systems*, Vol.3, pp3-25, 1995.
- J. K. Wu, etc., Inference and Retrieval of Facial Images, *ACM Multimedia Systems*, Vol. 2, pp1-14, 1994
- H. Niemann, J. K. Wu, Neural Network Adaptive Image Coding, *IEEE Trans. Neural Networks*, Vol. 4, No. 4, pp. 615-627, 1993
- Wu, J.K., T. Chen and L. Yang, A Knowledge-based Pictorial Information System ISDBS, *Scientia Sinica*, No.2, 1990, p198-203.
- J.K.WU, T.Chen and L.Yang, QPP - A versatile query language for KGIS, *Int. J. of GIS*, Vol.3, No. 1, 1989.
- J. K. Wu, R. E. Burge, Adaptive bit allocation for image compression, *Computer Graphics and Image Processing (CGIP)*, Vol. 19, 1982, pp392-400.

05/05/05

Patent

- WU Jian Kang, ZHANG Wei Ming, LI Yi Qun, DONG Zi Qiang, Title: Linear object vectorization in colour/grayscale images, 06/98, PCT/SG98/00072, 16 September 1998, Singapore Application No : 200101557-7, Singapore Patent No : 79684, Filed: 16 Sept 1998, Grant Date : 30 April 2003, I2R Ref: 06/98 - ETPL Ref: KRDL/P/0963/0967/SG
- Wu Jian Kang, Sun Qibin and Robert Deng, Legitimacy Protection of Electronic Document and its Printed Copy, 25/99 PCT/SG99/00086, 21 August 1999, US 09/486,940, 3 March 2000, Canada 2,374,195, GB2365184, grant date: 16 June 2004, China 99816827.0, Japan 2001518984, India IN/PCT/2001/01089/DEL, Singapore 200106938-4.
- S. Huang and J. K. Wu, Optical watermark, filed in Singapore and PCT on 15 Sep 2000 by TrustCopy, PCT/SG00/00147, USA 09/810971, Australia 75690/00, Europe 00964869.2 Granted Oct 2004, China ZL 00802036.1, granted on Oct 06 2004, Japan 2001-549269, Korea 2002-7015294

8 Appendix: Brief Description of Major Research Achievements

My research focus was on analysis, recognition and protection of digital media contents such as images, audio and video. Here is a summarization of a few major achievements for the latest 10 years.

8.1 Multimodal Spatiotemporal Data Stream Segmentation

Today, networked databases and web link all computing machines in the world together. Sensor networks provide a powerful platform to link the real world (people, animals, infrastructure, environment and even space) together. Database concepts and tools provide very useful means for application development on top of sensor networks. But the readings from sensors are not "well-formatted", rather, they are multimodal spatiotemporal streams, and cannot be directly incorporated into the database. A bridge must be built between the sensor networks and databases before we can freely use existing database concept and tool to monitor situations and track the changes of the real world.

University of California at Berkeley developed TinyDB, Cornell University database group has project "Courgar". These two works either explicitly or implicitly assume that the sensor networks consist of a massively distributed sensor nodes like UCB motes. Collected data are of simple type, or self-explainable data, such as temperature, noise level. Stanford uses stream server, which is not feasible for sensor networks.

We have proposed a new approach, "Stream Segmentation", by modelling the sensor network and real world using random field, defining dynamic active sensor regions for collaborative processing, employing dynamic Bayesian network models to perform temporal segmentation, and finally, convert the data stream into well-formed database records.

The work is in progress, with applications in both healthcare and tracking of moving targets. A lot of new findings are expected.

8.2 Formalism for content-based multimedia retrieval

A collection of data by itself means nothing. A well organized multimedia data can help the users to find whatever interests them. The difficulty here is that data are objective, while interpretations are subjective. Most of existing work reports application-oriented research results. Little is done on systematic exploration of that subject. The formalism here is to develop an engine which can

build bridges from multimedia database to users/applications. Funded by Real World Computing Japan (next generation computing program of Japan) since 1994, and late collaborated with CNRS and NUS SOC from 2000, we have conducted a systematic study and made significant achievements on formalism for content-based multimedia information indexing and retrieval. As such, our group is regarded as **"one of the pioneer groups in the world in this field"** (a reviewer comments of my book in 1998). After years of research, for the first time, we have

1) formally defined a framework, including the definition of multimedia object from low level raw data to high level interpretation, together with propagation function from one level to other. With this unified framework, we have a basis to develop functional blocks to fulfil our goal – an entire formalism.
2) Proposed a theory of "retrieval by recall", where a multi-level similarity function is used to characterise the retrieval system, a loss function is proposed as a criterion of performance of retrievals, and learning algorithms are developed to "tune" the system for the best performance for a specific application. The importance of this work is, it plays a similar role as classification theory in pattern recognition
3) proposed a semantic indexing method. Content-based indexing organises data in semantic level and bridges the gap between database and knowledge base. Currently available techniques indexes using vector feature measures, which are not adequate to be called as content-based. The proposed content-based indexing technique, ContIndex has 1) icon images created automatically to facilitate visual browsing; 2) nodes spatially organised by self-organisation neural networks; 3) multi-modal feature measures fused to create consistent categories by LEP (learning by Experience and perspectives) neural network which was first proposed by the author; and 4) vertical, horizontal, and multi-resolution visual browsing.
4) developed a fuzzy indexing method which links human interpretation with the feature measures of media information. Image data are inherently visual. The description of visual characteristics of images is imprecise. Fuzzy retrieval of images stored in a feature-based image database is a natural means to access the data. The proposed method includes: 1) a fuzzy image database model; 2) a novel concept of fuzzy space; and 3) novel functions for fuzzy query processing in fuzzy space. A reviewer's comments: **open a new research topic for others to explore.**
5) proposed a bench marking procedure and formula for multimedia database;
6) developed 3 applications (Face, Trademark, and Home Photo Album) to show the value of our formalism.

8.3 Face Recognition

Developed *world first* face recognition and retrieval system (CAFIIR) in 1992, at that time there is only MIT face recognition algorithm EigenFace, and CMU Kanade PhD thesis.

Face recognition is a challenging research topic for the last decade. The challenges are due to variations of background, capturing conditions, and facial features. We have been attacking these challenges by developing techniques:

- Real-time face region locating and tracking to cancel background variations;
- Accurate eyes locating for face image normalisation to remove rotation and scale variations;
- Invariant features to minimise the effect of facial feature changes;
- Unique method to handle pose variations;
- Face recovery method to cancel the light variation; and
- Use recognition-by-recall to handle time-varying faces.

05/05/05

The system was demonstrated at RWC Symposium'98 with comparison to the world's most popular face recognition software. It convinced the symposium that ours are much more robust to facial feature changes – especially, hair changes. The system also won the Best Poster Technology Innovation Award at Biometrics 2002. A company was spin-off using the technology.

8.4 A suite of technology for document protection and authentication

Documents form the basis for all commercial transactions and administration. The research "authentication of electronic and printed document" was designed to create revolutionary technology and develop a suite of products which provide a totally new fundamental infrastructure in handling business and administrative documents and would impact the entire business world in terms of speeding up the whole business process, cutting cost and yet requiring only minimal or no change to the existing business process. This suite of technologies includes:

1. A framework and principle which enables the total protection and authentication for the whole document process from the creation of electronic document to its processing, delivery, until printing and verification.
2. Multi-layer optical watermark - a novel and very secure optical watermark which protect the authenticity of both electronic document and its printed version.
3. Secure controlled printing – It ensures authorized number of originals printed either locally or remotely, online or off-line, linking electronic document with printed document in a unique way.
4. Electronic signature / seal - the signature / seal are tightly coupled with document content and time. It works for both electronic and paper document.
5. Printed document authentication using printing signature.
6. Proprietary document format and universal format converter, providing additional protection and flexibility for users to use any document editing and process tools.

Using these technologies, a suite of products have been developed by Trustcopy, a spin-off from KRDL/I2R, including:

1. TrustBL, used by PIL (pacific international lines), OOCL (oriental ocean container lines) and Portnet/PSA for online processing and delivery of bill of lading
2. TrustTradeDoc (WebLC), joint development with Citibank to fulfill the payment based on on-line trading document processing;
3. TrustTicket, online ticket booking and printing system used by Sistic
4. TrustSeal, Partnership with HP to allow HP printer users to do secure printing in their offices and homes
5. TrustMark, brand protection labels now used by famous liquor dealers such as Pernod Ricard.
6. TrustE-seal system, used by Courts in China to endorse legal documents electronically.

Giga Information Group, a prestigious US consultant company, commented (09/2001):
"TrustCopy (TC) has developed a technology that has tremendous potential. Its solution is technically superior to its nearest competitors, and Dr. Wu, TC's CEO, is an exceptionally bright

visionary. The market for products like TrustCopy represents a significant opportunity. TC links the printed and electronic world in a unique and useful way."

Trusteopy attracted $7million fund from 3i, the largest VC in Europe in 2002, a difficult time for investment.

The technologies are described in 5 patents.

8.5 A new generation map digitization method.

A map digitisation software product, NeuroVec has been developed. It was thoroughly tested by end user. The test results show that NeuroVec is 2-20 times faster than Intergraph GeoVec at the time of testing (1996), which represents the state of the art of the technology.
The key techniques developed in this project include:

- A new paradigm for line tracing on colour and grey scale images including a new line sample point selection, line point recognition, automatic tracing and interactive problem solving.
- Fusion of colour and 2-D and 3-D line properties in line recognition and tracing,
- Feature space optimisation,
- Automatic adaptive line tracing.
- Intelligent interactive problem solving.

The technology is applicable to high- resolution satellite image interpretation - a huge application area.

8.6 Watermarking for copyright and legitimacy protection

Developed a set of technologies in the area of copyright protection and DRM for image, audio and video, based on the idea of content adaptation (around 20 publications and 6 patents).